Malthus, Darwin, & Evolution: If the Intensity of Selection Increases in the Transition from Asexual Reproduction to Sexual Reproduction, the Intensity of Selection Decreases in Species that have Fewer Offspring and More Parental Investment

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Abstract: Natural selection is sometimes treated as a variable, and is sometimes treated as a constant. In this paper I seek to address when and how natural selection is treated as a variable, in addition to natural selection being treated as a constant as an explanatory force in the evolution of species. Thus, for example, it may be recognized that if the intensity of natural selection increases in the transition from asexual reproduction to sexual reproduction, the intensity of natural selection decreases somewhat in species that have fewer offspring and greater physical and parental investment.

Keywords: natural selection; Darwin; Wallace; cloning; positivism

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INTRODUCTION: Natural selection is sometimes treated as a constant, and is sometimes treated as a variable. This paper seeks to clarify when and how natural selection is treated as a variable or as a constant.

Physicists, biologists, philosophers of science, and computer scientists, and others have commented that natural selection has a different kind of logic than other principles or explanations in science. (Hempel 1962; Kuhn 1962; Weinert 2008; Caplan 1984; Howard 2009; Charlesworth and Charlesworth 2009; Bongard 2009; Lightman 2005; Volk 1995) Biochemist Nick Lane, a former editor of the journal *Nature*, comments that, “the problem is that science is all about predictions . . . Biology is less predictive, and has no laws to compare with those of physics. . . the predictive power of evolutionary biology is embarrassingly bad . . . I do not mean by this that evolutionary theory is wrong -- it is not -- but simply that it is not predictive.” (Lane 2015; cf. Dawkins 2011) Lane’s criticism may be related to Darwin’s natural selection being treated as a constant or near constant across species when it is discussed as a force of evolution, or as a constant or near

constant across species with sexual reproduction. What explains the evolution of primate species? Natural selection. What explains the evolution of the human species? Natural selection. What explains the evolution of primordial species in the genus *Homo*? Natural selection. It is stated that natural selection explains the evolution of fish species, and that natural selection explains the evolution of dolphins, whales, and other sea mammals. It is stated that natural selection explains the evolution of reptiles, and that natural selection explains the evolution of bird species. It is stated that natural selection explains the evolution of simple-celled life, and that natural selection explains the evolution of complex, multicellular life. Thus, as a force of evolution natural selection is treated as a constant across species.

However, particular studies of the evolution of species in specific environments or ecologies will treat natural selection as a variable, as in studies that seek to show that different selection pressures or natural selection checks in an environment or ecology vary over space and time. (see, e.g., Wilson 2000; Alcock 2013) Population size and population distribution in an environment or ecology may be related to different selection pressures or checks of natural selection in an environment or ecology, such as temperature and climate, or the presence or absence of different predators, parasites, and disease, or the variable distribution of nutrients and food sources in an environment or ecology (which may also be related to other factors such as climate or presence of parasites or disease). In the human species itself, natural selection checks against population growth in the human species have been gradually removed since the

18th and 19th centuries, as children and adults had less contact with disease pathogens of farms, horse travel, or the comparative lack of sanitation of early modern towns and cities. Moreover, increasing productivity of farming increased the size of the food supply, and its distribution across human populations. The result was tremendous population growth by the late 19th century, and into the 20th and 21st centuries.

1. **The Theory of Natural Selection and the Darwin-Wallace Pattern**: It is also possible to think of the theory of natural selection in relation to the Darwin-Wallace pattern of constant or near constant 'perpetuating' variations across organisms in species. Charles Darwin and Alfred Russel Wallace sought to establish, from species to species to species, that there are constant or near constant slight variations across individual organisms in species. Thus, (1) given some mechanism of genetic inheritance (Darwin and Wallace still used a concept of biological inheritance derivative of Aristotle's conception of 'pangenesis'), and given (2) Malthus' observation of the potential geometric increase in the generational progeny of organisms that is in conflict with (3) factors against the potential geometric increase in progeny of organisms over generations, namely, war, plague, disease, famine, or, in the case of the distribution of animals and plants, predation, parasitism and disease, the availability of nutrients and food sources, and climatic and geological variability, and given (4) the Darwin-Wallace pattern of constant or near constant slight variations across organisms in species, from species to species, more favorable variations for survival and reproduction

> are likely to be conserved and retained by the breeding populations of species, and less favorable or deleterious variations for survival and reproduction are likely to be eliminated by the breeding populations of species. Moreover, Darwin and Wallace reasoned, the breeding populations of species (and also sub-species or varieties) that are more successful in retaining favorable variations for survival and reproduction in an environment or ecology, are more likely to survive against other species.

Charles Darwin (1859) himself commented that the theory of natural selection is in effect the principle of Malthus extended and applied "with manifold force to the whole animal and vegetable kingdoms." It is interesting to observe that the 'Malthus factor' of the potential geometrical increase in the progeny of organisms over generations varies in the adaptive structures and behavioral characteristics of organisms (i.e., birds and mammals have fewer offspring and greater parental investment and care than other orders and classes of species, such as insects, reptiles, or techniques of spawning by fish, and, analogously, fruit and seed-bearing plant species have greater parental resource investment in progeny than ancestral species of plants or fungi that reproduce by spores), and that the Darwin-Wallace pattern of constant or near constant slight variations across organisms is absent or disappears in a population of pure clones.

John Maynard Smith and Eors Szathmary comment that the 'major transitions' in the emergence of greater complexity in evolution extend from the simplest life forms,

prokaryotes and eukaryotes, to the evolution and differentiation of complex organisms across species, the evolution of sexual reproduction and genetic recombination, and the emergence of language and culture (including technology) in the evolution of the human species. (Smith and Szathmary 1995; Smith and Szathmary 1997; Szathmary 2006; Dick and Lupisella 2009; Lane 2011; Ermini, Sarkissian, Willerslev, & Orlando 2015)

2. Evolutionary Transitions in Natural Selection: It is possible to consider the 'major transitions' of sexual reproduction and genetic recombination in the evolution of complex multi-cellular life, and sexual reproduction, genetic recombination, and the alternation of generations in plant species and some animal species, in contrast with cloning or asexual reproduction. As suggested, in a population of pure clones, the Darwin-Wallace pattern of constant or near constant slight variations across organisms disappears or is absent, and thus opportunities for natural selection across individual organisms in a population of pure clones are absent.

Thus, individual organisms of populations of species with sexual reproduction and genetic recombination are exposed to natural selection more than populations that reproduce asexually or by cloning, such as asexual bacteria, and are exposed to natural selection more than species that alternate generations in the sexual reproduction of species and the generation of progeny by cloning or parthenogenesis (in the generations of clones, genetic variability may be limited to mutation, transposable elements, or polyploidy and gene duplication instead of genetic recombination per se).

As suggested, it is interesting to recognize that in a population of pure clones, the pattern of constant or near constant slight variations across individual members of species established by Alfred Russel Wallace and Charles Darwin collapses, and opportunities for natural selection are absent. Thus, it may be recognized that in species of cloned organisms, such as asexual bacteria, or generations of clones in plant species, the intensity or severity of natural selection is less than in populations with sexual reproduction and recombination. This pattern is elaborated and displayed in Figure 1, "Evolutionary Transitions in Natural Selection (Overall Patterns)."

1. Evolutionary Transitions in Natural Selection (Overall Patterns)

Asexual Reproduction in Species	Sexual Reproduction, Alternation of Generations (Increases capacity for number of offspring with differential characteristics)	**Increase in Intensity of Natural Selection**
Sexual Reproduction by High Number of Offspring & Low Physical and Parental Investment (Echinoderms, Fish, Amphibians)	Sexual Reproduction with Low Number of Offspring and High Physical and Parental Investment (Birds, Marsupials, Mammals)	**Decline in Intensity of Natural Selection** (compared to Reptiles, or compared to Echinoderms, Fish, or Amphibians, that largely use the technique of spawning)

Moreover, as summarized in Figure 1, and also elaborated and displayed in Figure 2, "Evolutionary Transitions in Natural Selection in Relation to the Increase and Decrease of the Intensity of Natural Selection," and Figure 3, "Evolutionary Transitions in Natural Selection, and the Darwin-Wallace Pattern," in asexual species, genetic variability is more limited (consisting of mutation and polyploidy) compared to species with sexual reproduction and genetic recombination, or sexual reproduction, recombination, and the alternation of generations. Thus, it may be said that in the evolutionary transition from asexual reproduction in species to sexual reproduction, the intensity and severity of natural selection increases; however, by this standard, it also may be recognized that in the evolution of species the intensity and severity of natural selection may decline somewhat (even if it is still clearly present and an important force in evolution), as in the decrease in the number of offspring and the increase in the physical and parental investment in offspring by mammalian species (such as longer internal gestation, mammary glands, and parental investment), and also bird species and marsupial species compared to, say, the common though not universal technique of spawning of most fish species, amphibians, or echinoderm species.

2. Evolutionary Transitions in Natural Selection in Relation to the Increase and Decrease of the Intensity of Natural Selection

Asexual Reproduction in Species	Sexual Reproduction and genetic recombination (Increases capacity for number of offspring with differential characteristics)	**Increase in Intensity of Natural Selection**
Asexual Reproduction in Species	Sexual Reproduction and the Alternation of Generations (Increases capacity for number of offspring with differential characteristics and decreases the differential characteristics across offspring in generations of clones)	**Increase in Intensity of Natural Selection** (in generations with sexual reproduction and recombination), and **Decrease in intensity of natural selection across individual organisms** (in generations with reproduction by asexual cloning)
Sexual Reproduction by High Number of Offspring & Low Physical and Parental Investment (Echinoderms, Fish, Amphibians)	Sexual Reproduction with Low Number of Offspring and High Physical and Parental Investment (Birds, Marsupials, Mammals)	**Decline in Intensity of Natural Selection** (compared to Reptiles, or compared to Echinoderms, Fish, or Amphibians, that largely use the technique of spawning)

3. Evolutionary Transitions in Natural Selection, and the Darwin-Wallace Pattern

Asexual Reproduction in Species (Darwin-Wallace pattern is primordial or limited to mutation, or possibly transposable elements or gene duplication)	Sexual Reproduction and genetic recombination (Increases capacity for number of offspring with differential characteristics)	The Darwin-Wallace pattern increases	**Intensity of Natural Selection Increases**
Asexual Reproduction in Species (Darwin-Wallace pattern is primordial or limited to mutation, or possibly transposable elements or gene duplication)	Sexual Reproduction and the Alternation of Generations (Increases capacity for number of offspring with differential characteristics and decreases the differential characteristics across offspring in generations of clones)	The Darwin-Wallace pattern increases in generations with sexual reproduction and recombination compared to reproduction by asexual cloning, and decreases in generations that reproduce by asexual cloning	**Intensity of Natural Selection Increases and Decreases**
Sexual Reproduction by High Number of Offspring & Low Physical and Parental Investment (Echinoderms, Fish, Amphibians)	Sexual Reproduction with Low Number of Offspring and High Physical and Parental Investment (Birds, Marsupials, Mammals)	The Darwin-Wallace pattern is present since species reproduce by sexual reproduction and genetic recombination	**The Intensity of Natural Selection Decreases**

3. Natural Selection as a Constant, and Natural Selection as a Variable: While natural selection is commonly treated as a constant or near constant as an explanatory force across species in the biological sciences, natural selection may be recognized as a variable that increases or declines in its severity or intensity with evolutionary transitions in modes of sexual reproduction and degree of physical and parental investment (in addition to or independent of attempts to assess a complex set of selection pressures in a given habitat or environment, and the severity or intensity of each).

Conceptualizing and clarifying when and how natural selection is a constant, or used as a constant in evolutionary theory, may be useful to the biological sciences, and 'biologically inspired computing,' including new lines or new kinds of theory and predictive science. For example, given natural selection as a constant as a force of evolution, and given that comparing a population of clones to a natural population of the human species identifies assortative mating as a variable (i.e., natural populations have more assortative mating across categories of dissimilar characteristics and similar characteristics than populations of clones), it is possible to propose that increasing assortative mating may explain greater brain encephalization, greater brain complexity, and greater diversity of behavioral characteristics in the evolution of species, including humans compared to primate species, sea mammals compared to fish, and bird species (including flight, song, and greater parental investment) compared to reptiles. (Stevens 2013)

Alternatively, if natural selection is treated as a variable, it may be recognized that cloning and the presence of clones may decrease natural selection in different ways: the presence of clones reduces the intensity of natural selection across the population of clones; thus, it has been recognized that cloning reduces Darwinist competition: 'Competition between the mitochondria in a single cell, and the consequent evolution of selfish mitochondria, is largely suppressed because all of the mitochondria in a single individual [organism] are genetically identical'; (Smith and Szathmary 1999); in the alternation of generations in plant species, and some animal species, generations of clones reduce Darwinism or natural selection across the clones (and genetic variability across the clones is limited to mutation, transposable elements, and polyploidy and gene

duplication); however, the presence of clones may move the unit of natural selection to a higher level of organization (that includes the clones), as in the branching patterns of different clonal cell lines in the cellular growth and differentiation of multicellular life, or colonies of clones in plant species or some animal species (like aspen trees or corals).

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